The Great Lakes Entomologist

Volume 26
Number 3 - Fall 1993 *Number 3 - Fall 1993*

Article 2

October 1993

Dytiscidae and Noteridae of Wisconsin (Coleoptera). IV. Distribution, Habitat, Life Cycle, and Identification of Species of Agabini (Colymbetinae)

William L. Hilsenhoff
University of Wisconsin

DYTISCIDAE AND NOTERIDAE OF WISCONSIN (COLEOPTERA). IV. DISTRIBUTION, HABITAT, LIFE CYCLE, AND IDENTIFICATION OF SPECIES OF AGABINI (COLYMBETINAE)[1]

William L. Hilsenhoff[2]

ABSTRACT

Adults of 24 species of *Agabus* and 10 species of *Ilybius* were collected in Wisconsin over the last 32 years. Keys and notes on identification are provided to facilitate identification of adults of these species and six others that may occur in Wisconsin. *Agabus* larvae were separated from those of *Ilybius* by the more posterior position of the dorsal seta of the basal setal whorl on the urogomphus, the number and location of spines on the metatarsi, and the presence of long setae on the last abdominal segment of most species. Information on distribution and abundance in Wisconsin, habitat, and life cycle is provided for each species based on collection records for 8,460 adults, and those larvae that could be identified with reasonable certainty. All species of *Ilybius* had similar life cycles, which were predominantly univoltine with larvae overwintering and completing development in the spring, and partially semivoltine with both adults and larvae overwintering. Lentic species of *Agabus* had three types of life cycles, with most larvae developing in spring. Types 1 and 2 were univoltine with adults overwintering in aquatic habitats (type 1) or terrestrial habitats (type 2). Type 3 life cycles were mostly univoltine with eggs overwintering, but also semivoltine to varying degrees with adults also overwintering in terrestrial habitats. Lotic species of *Agabus* had variable univoltine life cycles with adults, and sometimes also larvae, overwintering.

Part I of this study contains a generic key to adults, and information on collecting efforts, measurement of specimens, and general life cycles of Dytiscidae (Hilsenhoff 1992). It also has a map of Wisconsin with numbered counties that are grouped into nine areas. County records listed below for each species refer to numbers on this map. The abundance of each species in nine areas of Wisconsin and in McKenna Pond is reported in Tables 1 and 2. Only 118 Agabini and 10 species were collected at the Leopold Memorial Reserve (Hilsenhoff 1993); these collections are recorded in Tables 1 and 2 under the south-central area. *Agabus ambiguus* (52) and *A. disintegratus* (29) were the most abundant species found there. Six species and 11 specimens from the collection of Walter Suter, Carthage College, were also included in this study.

Two genera of Agabini, *Agabus* and *Ilybius*, occur in Wisconsin. Larson revised *Ilybius* in North America in 1987, providing keys, descriptions, and

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[1]Research supported by the College of Agricultural and Life Sciences and the Graduate School at the University of Wisconsin-Madison.

[2]Department of Entomology, University of Wisconsin, Madison, WI 53706.

Table 1. Numbers of adult *Agabus* from nine areas of Wisconsin and McKenna Pond (McK) (Hilsenhoff 1992) collected between 1962 and 1993.

	NW	NC	NE	WC	C	EC	SW	SC	SE	McK	TOTAL
Agabus aeruginosus	0	0	0	0	0	0	7	0	0	2	9
A. ambiguus	21	24	36	74	34	56	90	231	64	20	650
A. antennatus	1	0	0	19	3	10	18	59	34	451	595
A. anthracinus	289	220	192	156	100	12	8	50	44	6	1,077
A. bicolor	15	17	30	1	0	0	0	0	1	0	64
A. bifarius	102	50	53	21	37	118	13	11	21	10	436
A. canadensis	0	0	0	0	0	0	1	0	0	0	1
A. confinis	0	2	1	0	4	0	0	1	0	0	8
A. confusus	0	0	0	0	0	0	0	5	0	0	5
A. discolor	3	18	2	0	0	0	0	0	3	0	26
A. disintegratus	0	1	0	7	6	1	6	46	13	10	90
A. erichsoni	28	20	239	11	9	1	2	1	0	0	311
A. falli	14	3	10	115	21	53	78	97	20	86	497
A. gagates	0	0	0	0	0	0	0	7	0	0	7
A. immaturus	0	0	2	0	0	0	0	0	0	0	2
A. inscriptus	29	0	2	1	5	2	1	4	0	3	47
A. leptapsis	0	4	6	0	0	0	0	2	0	0	12
A. phaeopterus	23	35	297	4	27	26	4	7	2	4	429
A. punctulatus	2	1	4	54	11	55	3	75	23	322	550
A. semipunctatus	317	142	203	123	136	72	45	42	69	49	1,198
A. semivittatus	0	0	0	0	0	20	9	15	10	1	55
A. seriatus	3	2	5	12	1	12	38	146	22	0	241
A. subfuscatus	7	6	6	18	34	21	11	18	8	66	195
A. wasastjernae	0	11	12	0	0	0	0	0	0	0	23

distribution maps for the 14 species he recognized. Four species are Holarctic; most others have a northern or boreal distribution in North America. Currently, Larson (1989, 1991) is also revising *Agabus* in North America; this genus was last revised by Fall in 1922. Adults of 24 species of *Agabus* and 10 species of *Ilybius* were collected in Wisconsin over the last 32 years; additional species eventually may be found. This study is based on 6,528 adult *Agabus* and 1,932 adult *Ilybius*; numerous larvae that could be identified were also studied.

Adults of *Agabus* and *Ilybius* are similar in appearance, and while species within *Ilybius* appear to be closely related, those within *Agabus* are more diverse and the genus ultimately may be divided (Larson 1989). Adults of both genera are characterized by a pair of dark rufous spots between the eyes and a

Table 2. Numbers of adult *Ilybius* from nine areas of Wisconsin and McKenna Pond (McK) (Hilsenhoff 1992) collected between 1962 and 1993.

	NW	NC	NE	WC	C	EC	SW	SC	SE	McK	TOTAL
Ilybius angustior	2	2	4	0	1	1	0	0	0	0	10
I. biguttulus	27	114	58	61	81	17	54	78	19	83	592
I. confusus	1	0	0	3	0	0	0	0	10	0	14
I. discedens	44	82	11	0	4	0	0	0	0	0	141
I. fraterculus	4	1	7	3	25	4	1	39	32	720	836
I. ignarus	0	5	1	4	16	24	3	13	7	2	75
I. incarinatus	0	0	1	2	1	12	21	42	13	0	92
I. picipes	18	20	8	20	18	9	5	22	7	5	132
I. pleuriticus	9	16	4	5	4	1	0	0	0	0	39
I. subaeneus	1	0	0	0	0	0	0	0	0	0	1

short row of spines on the ventral surface of the metatibia near the posteroapical angle. Except for *Agabus disintegratus*, which has striped elytra, adults of both genera in Wisconsin are mostly devoid of distinctive markings. Adults of *Ilybius* have on each elytron a sublateral pale streak and usually also a pale macula near the apex; these marks also occur on elytra of a few species of *Agabus*. The dorsal surface of adults ranges from brown to black, with rufous lateral coloration in several species. Colors described below are for beetles preserved in ethanol; colors may be darker in pinned specimens. Adults of most species of *Ilybius* are larger than those of most *Agabus*; *Ilybius* adults can be recognized by the distinctly unequal length of the metatarsal claws, which in *Agabus* are equal in length or nearly so.

Identification of larvae at the species level is normally not possible because larvae of most species have not been associated with adults, and published descriptions of larvae are often too incomplete or inaccurate to be diagnostic. I developed a provisional key to separate larvae of 14 species of *Agabus* and seven species of *Ilybius*, but only species with described larvae can be identified with reasonable certainty. Larvae of *Ilybius* and *Agabus* (except *A. confusus*) have only primary setae on the urogomphi. Published keys do not adequately separate larvae of these two genera and may lead to erroneous identifications. Larvae of the two genera may be separated as follows.

Agabus – Dorsal seta of basal urogomphal whorl distinctly posterior to other two setae, or secondary setae present; anteroventral spines on metatarsus not paired with posteroventral spines, which are usually less numerous or absent; last abdominal segment usually with long, thin setae in addition to spine-like setae.

Ilybius – Dorsal seta of basal urogomphal whorl not posterior to other two setae; anteroventral spines on metatarsus more or less paired with posteroventral spines; last abdominal segment lacking long thin setae.

Third instar larvae of all species of *Ilybius* and some lotic species of *Agabus* overwinter. Except for one unknown species, no lentic *Agabus* larvae were collected in the autumn. This unknown species occurred in southeastern Wisconsin where one larva was found in a permanent pond on 9 November and two more were collected from a swimming pool on 19 April. These larvae were identified as *Agabus* because of the distinctly posterior location of the dorsal seta on the basal urogomphal whorl and a lack of posteroventral spines on the metatarsus.

A key to adults of species that occur or may occur in Wisconsin appears below under each genus; a size-range for adults from Wisconsin is included when four or more were collected. The WC/WS ratio (Larson 1987) is used in the keys to compare the width of metasternal wings. WS is the narrowest width of the metasternum adjacent to the mesocoxal cavity (not including the bead or ridge adjacent to the mesocoxa) and WC is the width of the metacoxal plate measured on the same line (Fig. 1). Identification of adults of *Ilybius* and several species of *Agabus*, especially *confinis*-group species (Larson 1989) identified by couplets 23–26 and 28–30, may be difficult for persons not familiar with these genera and will be greatly aided by a reference collection. Teneral adults may create special identification problems because characters involving color may not apply. Following each key is information about the species, which includes distribution and abundance in Wisconsin, general range in North America, habitat, life cycle, and identification.

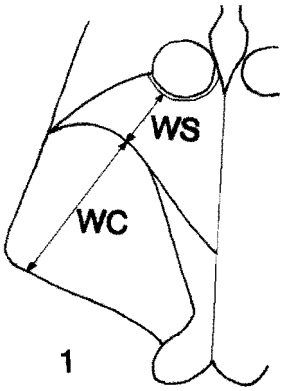


Figure 1. Right half of metasternum of *Agabus* showing measurements across metacoxal plate (WC) and wing of metasternum (WS).

Agabus Leach, 1817

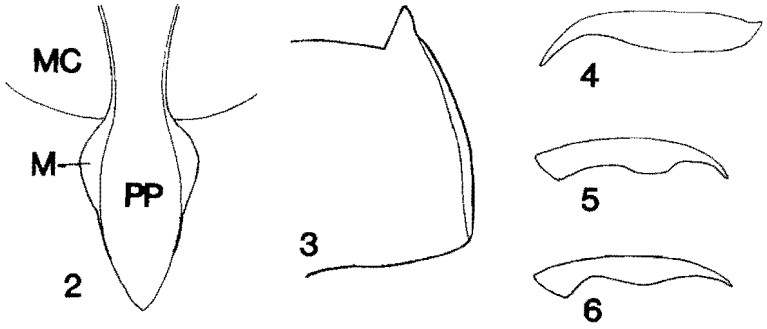
Three types of univoltine life cycles apparently occur in lentic species of *Agabus* as follows. **Type 1**—Adults overwinter in aquatic habitats, mate and oviposit in early spring, with most dying shortly thereafter; eggs hatch after a short incubation period and larvae complete development by June, except in cold habitats. Large numbers of adults in early spring and substantial numbers again in autumn, with most teneral adults being collected in June, are evidence for this life cycle. **Type 2**—This life cycle is the same as type 1, except adults overwinter in terrestrial habitats as reported by Galewski (1964). Numerous adults in early spring, teneral adults in June, and absence of adults from aquatic habitats after mid-September provide evidence for this life cycle. **Type 3**—Species overwinter primarily as eggs as reported by James (1969), with a remnant population of adults also overwintering in terrestrial habitats. Overwintering eggs hatch in early spring, larvae complete development by June, most adults mate in late spring and summer, and females lay eggs that hatch the following spring to complete a univoltine life cycle. Some adults overwinter and return to ponds in spring to mate and oviposit, thus completing a semivoltine life cycle for a portion of the population. I believe overwintering adults are individuals that did not mate the previous summer, perhaps because they developed in cold habitats and did not emerge until late summer. Evidence for this type 3 *Agabus* life cycle, which predominates in Larson's (1989) *confinis*-group, is a small percentage of adults in spring collections, teneral adults mostly in June, and an absence of adults after mid-September. Because most adults emerge in June, and the number of overwintering adults is very small in most species, I believe that the semivoltine life cycle described by Nilsson (1986) for 13 species of northern European *Agabus* occurs in only a small portion of the population of most *confinis*-group species at Wisconsin's much more southern latitude. An exception is *A. bicolor*, which may be only semivoltine. Adults of all lentic and lotic species apparently may aestivate in terrestrial habitats during the summer, especially in dry summers when shallow, vegetated, aquatic habitats are virtually absent.

Life cycles are different in the four lotic species. Both *A. ambiguus* and *A. confusus* overwinter as larvae and adults, with larvae of *A. ambiguus* occurring throughout much of the year. Life cycles of *A. seriatus* and *A. semivitta-*

tus are similar to the type 1 life cycle described above, except that larvae develop in summer instead of spring, and adults emerge in autumn.

Key to Species of Adult *Agabus* in Wisconsin

1. Elytra testaceous with black vittae; 7.3–8.5 mm long . . . *disintegratus*
   Elytra not vittate 2
2(1). Pronotum mostly brown to rufotestaceous 3
   Pronotum black or rufopiceous, at least on most of disc 4
3(2). Metasternum and anterior of abdominal sterna 2–6 infuscate; antenna infuscate or black apically; smaller, 7.6–8.6 mm long . . *antennatus*
   Metasternum and abdominal sterna not infuscate; antenna not infuscate or black apically: larger, 9.2–10.0 mm long (Fall 1922). . . *ajax*
4(2). Elytra with aciculations, longitudinal on disc and becoming transverse apically, and with fine secondary reticulations; 6.1–7.0 mm long . . . . . *bifarius*
   Elytra without aciculations 5
5(4). Very large, black beetles, 12.3–12.8 mm long; elytron with impressed sutural stria and obscure sublateral pale spot; lotic . . . . *confusus*
   Smaller, < 11.6 mm long; if more than 10.5 mm long and black, elytron without impressed sutural stria and sublateral pale spot . . . 6
6(5). Epipleuron dark rufous to black, usually similar in color to metasternum 7
   Epipleuron testaceous and distinctly paler than dark rufous to black metasternum 20
7(6). Elytral meshes with distinct, reticulate, secondary microsculpture 8
   Elytral meshes without distinct, reticulate, secondary microsculpture 11
8(7). Meshes of elytral sculpture large, often elongate, and without micropunctures at intersections of lines 9
   Meshes of elytral sculpture small, never elongate, and having micropunctures at intersections of lines 10
9(8). Elytra black, same color as pronotum; basal margin of pronotum distinctly sinuate laterally; row of punctures on posteroventral margin of metatibia confluent and forming a groove; larger, 9.4–10.2 mm long . . . . . *leptapsis*
   Elytra usually dark brown and paler than pronotum; basal margin of pronotum not sinuate; posteroventral punctures on metatibia not confluent; smaller, 7.8–9.1 mm long. . . . . *ambiguus*
10(8). Smaller, 6.2–7.2 mm long . . . . . *wasastjernae*
   Larger, 8.0–8.5 mm long (Wallis manuscript) . . . . . *opacus*
11(7). Margin of prosternal process greatly widened past middle (Fig. 2); elytra with long sublateral pale streak that may reach apical spot; 7.2–8.8 mm long. . . . . *semivittatus*
   Margin of prosternal process not greatly widened past middle; sublateral pale streak, if present, not elongate. 12
12(11). Variously-sized micropunctures in many meshes of elytral sculpture 13
   Micropunctures infrequently in meshes, ... 14
13(12). Elongate; pale spots absent from elytron, except occasional, obscure, sublateral spot; larger, 8.3–10.2 mm long. . . . . *seriatus*
   Broad, short; elytron with sublateral and subapical pale marks; smaller, 7.3–8.0 mm long (Fall 1922) . . . . . *obtusatus*
14(12). Larger, > 9.0 mm long; first 3 metatarsal segments with 1–3 large punctures dorsally on outer side 15



Figures 2–6. 2. Enlarged margin (M) of prosternal process (PP) of *Agabus semivittatus* posterior to mesocoxae (MC). 3. Right fourth of pronotum of *A. erichsoni*. 4. Right anterior protarsal claw (anterior view) of *A. canadensis*. 5–6. Right posterior protarsal claw (posterior view). 5. *A. subfuscatus*. 6. *A. phaeopterus*.

Smaller, < 8.5 mm long; first 3 metatarsal segments without large punctures dorsally on outer side 16

15(14). Pronotum indented laterally immediately posterior to anterolateral angle (Fig. 3); elytron without impressed sutural stria; gula black; 10.0–11.5 mm long . . . . . *.erichsoni*

Pronotum not indented laterally; elytron with lightly impressed sutural stria; gula rufous; 9.2–10.4 mm long . . . . . *.gagates*

16(14). Elytral sculpture coarse, with deeply impressed lines between meshes, and with micropunctures infrequent or obscure 17

Elytral sculpture fine, with lines between meshes not deeply impressed, and with many micropunctures at intersections of lines or in meshes 18

17(16). Meshes of elytral sculpture larger, about size of strial punctures; prosternal process black, elongated apically to extremely acute point; 7.2–8.4 mm long . . . . . *.anthracinus*

Meshes of elytral sculpture extremely small, much smaller than strial punctures; prosternal process rufous, not apically elongate; 6.7–7.8 mm long . . . . . *.falli* (many females)

18(16). Elytron black with rufous sublateral pale streak, which may be obscure or occasionally absent; pronotum black laterally, except for marginal bead; scattered micropunctures in lines and occasionally in meshes of elytra; smaller, 6.0–7.1 mm long . . . . . *.semipunctatus*

Elytron black on disc and rufous or rufopiceous laterally, without sublateral pale spot; pronotum rufous laterally inside of marginal bead; numerous micropunctures at junctions of lines in elytral sculpture; larger, > 6.7 mm long 19

19(18). Mesocoxae rufopiceous, similar to color of metasternum; apical half of prosternal process slender, only 1.5 X width at constriction; male with dense brush of setae on posterior of mesofemur; 6.7–7.4 mm long . . . . . *.aeruginosus*

Mesocoxae rufous, much paler than metasternum; apical half of prosternal process broadly rounded, twice width at constriction; mesofemur of male without a dense brush; 6.7–7.8 mm long . . . . . *.falli*

20(6). Large, > 9.5 mm long; elytra fuscous on disc and apically, broadly testaceous laterally, especially toward base; elytral meshes very

small and irregular, especially on disc; basal protarsal segment of male 2.5 times wider than distal segment; 9.6–11.0 mm long (Larson and Nilsson 1985) ..... *fuscipennis*

Smaller, < 9.2 mm long; elytral color and sculpture not as above; basal protarsal segment of male < 2.0 times wider than distal segment 21

21(20). Elytra same color medially as black pronotum, very broadly rufous laterally; 7.1–9.0 mm long ..... *bicolor*

Elytra may be infuscate on disc, but never black, and always paler than pronotum 22

22(21). Apical portion of prosternal process medially carinate, concave laterad of carina; 8.0–9.1 mm long ..... *confinis*

Prosternal process often convex apically, but never carinate and concave laterally 23

23(22). Elytral sculpture on disc of small, rather evenly-sized meshes that are slightly smaller than meshes with a micropuncture; micropunctures conspicuous, almost completely filling meshes 24

Elytral sculpture on disc of irregular-sized and -shaped meshes, which either are mostly very small or are often larger than those with micropunctures; some micropunctures may be small and inconspicuous 27

24(23). Pronotum with a reddish cast; gula and metacoxal plate rufous to rufopiceous, paler than metasternum; metasternal wing narrow, WC/WS (Fig. 1) > 3.2; 6.8–7.6 mm long (Larson 1991) ..... *immaturus*

Pronotum black; gula and metacoxal plate as dark or darker than metasternum, usually black; metasternal wing wider, WC/WS < 3.0 25

25(24). Pronotum broadly rufous laterally, width of rufous area about equal to width of anterolateral projection; anterior protarsal claw of male strongly curved at tip (Fig. 4); 6.6–7.6 mm long (Larson 1991) ..... *canadensis*

Pronotum not broadly rufous laterally; anterior protarsal claw of male not strongly curved at tip 26

26(25). Posterior protarsal claw of male widest and often angulate at apical third, suddenly narrowed in apical fourth (Fig. 5); pronotum not inflated, anterior of lateral bead rarely hidden in dorsal view; metatibia usually with > 4 posteroventral punctures; larger, 7.6–8.7 mm long ..... *subfuscatus*

Posterior protarsal claw of male widest at middle, gradually narrowed toward tip (Fig. 6); pronotum inflated so as to hide anterior portion of lateral bead in dorsal view; metatibia usually with < 4 posteroventral punctures; smaller, 6.5–7.9 mm long ..... *phaeopterus*

27(23). Elytra and pronotum piceous with an aeneous cast; numerous distinct punctures in lines of elytral sculpture; 5.7–6.6 mm long ..... *punctulatus*

Elytra distinctly lighter in color than pronotum; micropunctures often in meshes 28

28(27). Elytral sculpture obviously unequal and irregular throughout, with some meshes much larger than irregular-sized micropunctures 29

Elytral sculpture unequal basally on disk, with uniformly-sized micropunctures almost filling some meshes, which are larger than other meshes 30

29(28). Pronotum with lateral margin broadly rufous; metasternal wing narrow, WC/WS > 2.6; 7.0–7.9 mm long ..... *discolor*

Pronotum with bead and a very narrow area adjacent to it rufous;

metasternal wing broad, WC/WS < 2.4; 6.4–8.4 mm long (Larson 1991) ..... *thomsoni*

30(28). Larger, 7.6–8.7 mm long ..... *subfuscatus*

Smaller, 6.1–7.2 mm long ..... *inscriptus*

***Agabus aeruginosus* Aubé, 1838**

Distribution and Abundance: Rare in southwestern third (Table 1). County records: 49, 52, 54, 61. Range: ON-MA-FL-IA

Habitat: Adults were found in shallow ponds and marshes.

Life Cycle: All adults were collected between 21 March and 23 April, except one teneral adult that was found on 16 June. This indicates a type 1 or type 2 *Agabus* life cycle; I am uncertain where adults overwinter because so few were collected.

Identification: Adults resemble those of *A. falli* because of elytral sculpturing and general coloration. In addition to characters in the key, they differ from *A. falli* by having the lateral margin of the pronotum and anterolateral margin of the elytra more broadly and distinctly rufous; in *A. falli* little more than the bead of the pronotum is rufous. Adults are more broadly ovate than those of *A. falli*. Matta (1986) described the larva.

***Agabus ajax* Fall, 1922**

Distribution and Abundance: Not yet found in Wisconsin. Range: YK-LB+WY+UT.

Habitat: In Alberta Larson (1975) found adults amid emergent vegetation in shallow water along warm, exposed margins of permanent ponds in parklands and mixed forest areas.

Life Cycle: Larson (1975) did not collect adults before 20 June, and those collected in June and early July were mostly teneral. He concluded that they probably overwintered as larvae.

Identification: The relatively large size and light brown color of the pronotum, elytra, and venter are distinctive.

***Agabus ambiguus* (Say, 1823)**

Distribution and Abundance: Common statewide (Table 1). County records: 1–4, 7–8, 10, 12, 14, 16–24, 26–32, 34–35, 37–68, 70–71. Range: YK-NF-NC-CO-MN-MB-BC+WA.

Habitat: Adults occur in all types of habitats. From April through August, 84% were found in lentic habitats; from August through March, 58% were found in lotic habitats, especially seeps, spring ponds, and vegetated margins of streams, which Larson (1989) and I (Hilsenhoff 1986) believe to be their breeding habitats. Larvae I believe to be this species were collected only from lotic habitats, especially stream margins and spring ponds. These larvae fit Barman's (1972) description and illustrations, although he reported collecting them from a temporary pond.

Life Cycle: Forty larvae presumed to be this species occurred from 3 October to 10 June, with additional larvae being found on 3 August and 13 September. Different sizes and instars often were in the same collection. Teneral adults (7) were collected from 25 June to 29 September. Most adults overwinter since 82% were collected from February through April and several others (7%) were found from September into December, mostly in lotic habitats. Only 4% of adults were found from July through September, which suggests death of overwintering adults and aestivation of recently emerged adults, at least in dry summers. Larson (1989) observed copulating adults in

the fall, as late as mid-November, and also in early spring. I believe this species has a staggered univoltine life cycle, with mating and oviposition from September into early April. Eggs probably hatch after a short incubation period to produce larvae of various ages, which complete development from June to September. This accounts for the long emergence period and the presence of larvae and adults throughout the year.

Identification: The black pronotum and dark brown elytra with large meshes containing distinct reticulate microsculpture is a distinctive combination in adults. Occasional specimens with very dark or black elytra resemble the larger *A. leptapsis*, but adults of *A. ambiguus* are distinctly smaller and easily separated by other characters in the key. Barman (1972) described the larva.

***Agabus antennatus* Leech, 1939 = *A. clavatus* LeConte, 1859**

Distribution and Abundance: Common in southern third, uncommon in central third, very rare in northern third (Table 1). County records: 3, 25–27, 29, 39–40, 43, 48–49, 52, 54, 56–59, 61, 63–65, 67, 71–72. Range: AK-LB-MN-ND-UT.

Habitat: Shallow ponds in open areas are the normal habitat for this species. McKenna Pond, a shallow pond with sedges (*Carex*, *Eleochris*), cattails (*Typha*), and bur-reeds (*Sparganium*) around the margin, was the source of 76% of the adults that were collected.

Life Cycle: Sixty percent of the adults were collected in March and April, 16% in May and June, and 23% from mid-September into November; only 1% were found in July, August, and early September. All teneral adults (20) were collected between 2 and 29 June. Thirty-two larvae were found between 27 April and 8 June. This species has a type 1 *Agabus* life cycle.

Identification: Characters in the key separate adults from those of the larger *A. ajax*. Males have distinctly clavate antennae, which are not found in any other Wisconsin species. Watts (1970) described the larva, which has swimming hairs (not more than 10) on each metatarsus.

***Agabus anthracinus* Mannerheim, 1852**

Distribution and Abundance: Very common in northern third, less common farther south (Table 1). County records: 1–23, 25–27, 29–40, 43–44, 46, 48–49, 51, 57–59, 61, 65–68, 70–72. Range: AK-NF-MA-WV-ND-BC.

Habitat: Adults, including 31 teneral adults, were found in all types of permanent lentic habitats.

Life Cycle: Seventy-eight percent of the adults were collected in March and April, none before 28 March ; another 14% were found in May and June, and 5% were collected in July and August, one-fourth of which (13) were teneral. The remaining 3% were collected from September to 1 November, with only 3 adults (< 0.3%) being collected after 20 October. Teneral adults (31 in 18 collections) occurred between 28 June and 25 August, and more than 100 larvae that I believe to be this species were found from 15 May through 20 August, with final instar larvae not being found before 4 June. This indicates a type 2 *Agabus* life cycle. Larval development is delayed because overwintering adults return to various lentic habitats to feed and do not enter breeding sites to mate and oviposit before late April or May. Only one-sixth of the collections containing teneral adults were from sites where adults occurred earlier in the year.

Identification: Adults are a medium-sized *Agabus* with a coarse elytral microsculpture and an apically elongated prosternal process. They are totally black, except for appendages, rufous head spots, and the pronotal margin. In

teneral and recently-emerged adults, elytra may be a very dark brown. The larva is undescribed. Larvae tentatively identified as this species may include other species as well, especially *A. falli*, a common species for which I have not identified larvae.

***Agabus bicolor* (Kirby, 1837)**

Distribution and Abundance: Fairly common in northern third, very rare farther south (Table 1). County records: 1-3, 5, 12-15, 17-19, 23, 27, 65. Range: AK-NS-WI-MB.

Habitat: At least 64% of the adults were found in association with *Sphagnum*, almost all in black spruce-tamarack (*Picea mariana-Larix laricina*) swamps. The remainder were collected mostly from sedge-cattail marshes; two were found in shallow ponds.

Life Cycle: Overwintering adults enter a variety of shallow habitats in early spring to feed before flying to swamps, which I believe are their normal breeding sites. Adults were collected 31 March through 22 August, with 59% being collected in late March and April and only 12% being found after June; none were teneral. While this suggests a type 2 *Agabus* life cycle, all other species in Larson's (1989) *confinis*-group apparently have a type 3 *Agabus* life cycle, and it is reasonable to expect that *A. bicolor* also does. Because *A. bicolor* larvae develop in very cold water, they probably do not complete development until late summer. The late-emerging adults likely enter overwintering sites and mate the following spring, which would account for the large number of overwintering adults and absence of teneral adults. Thus, I suspect that this species has a type 3 *Agabus* life cycle that is mostly or entirely semivoltine.

Identification: Adults are easily distinguished from other species in the *confinis*-group because the black pronotum is narrowly rufous laterally and the elytra are also black, except for broadly rufous lateral margins. The larva is undescribed.

***Agabus bifarius* (Kirby, 1837)**

Distribution and Abundance: Common in northern two-thirds, fairly common in southern third. County records: 1-4, 6, 8, 10-13, 15-19, 21, 23-25, 27, 29-30, 32-33, 36, 39-40, 42-49, 54, 56, 59, 61, 64, 66-67, 71-72. Range: AK-LB-MA?-IL-WY-BC.

Habitat: Adults, teneral adults, and larvae identified as this species were collected from a variety of shallow ponds, marshes, ditches, and swamps.

Life Cycle: Adults were collected from 21 March to 13 August, with 57% being found in March and April and 39% in June. All adults that were collected in July and August (8 in 3 collections) were from black spruce-tamarack swamps in the north. Forty teneral adults were collected between 9 June and 19 July; 26% of adults collected in June and 33% of adults collected in July were teneral. Thirty-six larvae that fit Watts' (1970) description were collected between 11 May and 29 June . This species probably has a type 2 *Agabus* life cycle.

Identification: Elytral aciculations that are longitudinal basally and become transverse distally distinguish this species. The larva, which was described by Watts (1970), is easily recognized because of its short urogomphi, which are only one-third the length of the last abdominal segment.

***Agabus canadensis* Fall, 1922**

Distribution and Abundance: Very rare in west (Table 1). County record: 50. Range: YK-BC-MB-WI-SD+CO.

Habitat: The only specimen, a male, was collected from the margin of a stream on 19 May. Larson (1991) described the habitat as "temporary grassland and parkland ponds."

Life Cycle: A type 3 *Agabus* life cycle is most likely since this is the life cycle found in other members of Larson's *confinis*-group.

Identification: The broadly rufous margin of the pronotum and several punctures along the posteroventral margin of the metatibia will separate adults from those of *A. phaeopterus*, which they most closely resemble. The strongly curved apex of the anterior protarsal claw of the male is diagnostic (Fig. 4).

***Agabus confinis* (Gyllenhal, 1808)**

Distribution and Abundance: Rare statewide (Table 1). County records: 14, 18, 33-34, 38, 57. Range: AK-NF-WI-MN+WY+CO.

Habitat: Adults were found in sedge and cattail marshes, a sedge-grass ditch, black spruce-tamarack swamps, the margin of a lake, and headwater woodland pools of a soft-water stream.

Life Cycle: Two collections of teneral adults were made 22 June, which shows that larvae develop in the spring. All other adults were collected between 25 June and 22 August, except one that was found 29 April. This suggests a type 3 *Agabus* life cycle.

Identification: The medially carinate apical portion of the prosternal process with a concave area on each side of the carina is distinctive. Because of their relatively large size and fuscous elytra, adults most resemble those of *A. subfuscatus*. Nilsson (1982) described the larva.

***Agabus confusus* (Blatchley, 1910) = *A. amplus* Fall, 1922**

Distribution and Abundance: Very rare in south-central area (Table 1). County record: 57. Range: WI-KY-AR-MO.

Habitat: Two adults and at least 11 larvae were collected from Parfrey's Glen Creek; three larvae were reared to adult (Hilsenhoff 1974). All were collected from under grass covered banks in rapid current where this very small, rocky stream flowed through an open area. Since 1974, efforts to collect additional specimens at this site were unsuccessful, probably because the growth of trees and shrubs along the stream eliminated the grassy banks.

Life Cycle: Adults and larvae were collected 18 April; additional third instar larvae were collected 11 November and 1 April. Both larvae and adults apparently overwinter in the stream. Larvae collected 18 April were reared, becoming adults by 24 May. In the stream, larvae probably complete development and pupate in June.

Identification: Adults are easily identified by the key; because of their large size and sublateral pale streak they resemble *Ilybius* more than *Agabus*. Larvae are distinctive because they have numerous secondary setae on the urogomphi (Hilsenhoff 1974).

***Agabus discolor* (Harris, 1828)**

Distribution and Abundance: Uncommon in northern third, rare farther south (Table 1). County records: 3, 7, 12, 19, 66. Range: AK-BC-LB-NJ-IL-SD-CO.

Habitat: Almost 71% of the adults were collected from a black spruce-

tamarack swamp in June. Others were collected from ponds, including two teneral adults from a small cattail pond where an adult also was found in late March. One adult was collected from a ditch. Apparently both swamps and small cattail ponds serve as breeding sites.

Life Cycle: Adults were collected between 31 March and 11 August, with 15% being found before 6 June . Most adults (73%) were collected in June, including two teneral adults that were trapped 6–9 June. I believe this species has a type 3 *Agabus* life cycle.

Identification: The broadly rufous margin of the pronotum separates adults from other *confinis*-group species with uneven microsculpture on the disc of the elytra; in these other species usually only the bead is rufous. Elytral sculpture varies, with meshes being larger in some individuals than in others. Micropunctures within meshes are unequal in size and often very small; they do not completely fill meshes as in *A. inscriptus* or *A. subfuscatus*. About 70% of adults had distinctive, coarse, setose punctures on the prosternal process. Watts (1970) described the larva.

***Agabus disintegratus* (Crotch, 1873)**

Distribution and Abundance: Fairly common in southern third, uncommon in central third, very rare in northern third (Table 1). County records: 16, 26, 29–30, 36, 40, 46, 50–51, 54–55, 57, 60–62, 64, 66, 69–72. Range: ON-PQ-MA-NC-TX-CA-IA.

Habitat: All adults and larvae were collected from ponds in open areas, except one adult that was found in a sedge marsh.

Life Cycle: About 78% of adults were collected 27 March through 29 June and 21% 15 September through 6 November; only one was found in July, August, or early September. Eight teneral adults were collected 9–29 June, and 34 larvae were collected between 11 May and 29 June. This species has a type 1 *Agabus* life cycle. Aestivation of adults during the summer was documented by Garcia et al. (1990).

Identification: Adults of no other species of *Agabus* with vittate elytra occur in this region. The larva, which was described by Barman (1972), has at least 25 dorsal swimming hairs on each metatarsus.

***Agabus erichsoni* Gemminger and Harold, 1886 = *A. nigroaeneus* Erichson, 1837**

Distribution and Abundance: Common in northern third, uncommon in central third, rare in southern third (Table 1). County records: 2–4, 6, 9–13, 17–21, 25, 27, 30–33, 35–37, 39, 42, 49, 57. Range: AK-NF-MA-MN+CO+UT.

Habitat: Adults, including 60 teneral adults, were found in a variety of shallow ponds and marshes and occasionally in swamps. Seven larvae believed to be this species were collected from vernal ponds, and one was found in a permanent pond.

Life Cycle: James (1969) observed overwintering adults in southern Ontario in late March and April, which laid eggs in vernal ponds in May and June. The eggs then entered a diapause after brief embryonic development and did not hatch until the diapause was broken the following spring after three month's exposure to O° C. He found that larval development was completed in May and teneral adults appeared in mid-June; these adults then aestivated, but not in the bottom of dried-up ponds. In late March and April he found adults again in vernal ponds, thus completing a semivoltine life cycle.

In Wisconsin all adults were collected between 19 April and 14 August, 84% of them in June. Sixty teneral adults were collected between 13 June and

21 July (88% in June), and third instar larvae were found between 11 April and 23 May. Overwintering adults were rare, with only 9% of adults being found in April and May; they appeared in ponds about three weeks later than in southern Ontario (James 1969) due to Wisconsin's colder winters. I believe this species has a type 3 *Agabus* life cycle, with the univoltine life cycle predominating in Wisconsin and the semivoltine cycle playing a minor role.

Identification: The large size, black color, and the slight, but distinct notch just anterior to the anterolateral angles of the pronotum of adults (Fig. 3) are distinctive. Adults resemble those of *Ilybius*, but lack sublateral and subapical pale marks on the elytra. The larva was described by James (1969). His description fits larvae that I believe are this species, except that his illustration of the urogomphi does not show the dorsal seta on the basal whorl to be posterior to the other setae. Larvae differ from most other lentic *Agabus* larvae by lacking long setae on the last abdominal segment. They also resemble *Ilybius* larvae because the number of anteroventral and posteroventral spines on the metatibiae is similar.

***Agabus falli* (Zimmermann, 1934)** = *A. sharpi* Fall, 1922

Distribution and Abundance: Common in southern two-thirds, uncommon in northern third (Table 1). County records: 2–3, 6, 14, 16, 19, 23, 25–27, 29–30, 32–35, 39–40, 42–45, 47–49, 51–52, 54–57, 59, 61, 63–65, 67–68, 70–71. Range: AB-PQ-WI-ND.

Habitat: Almost all adults were collected from shallow ponds or marshes.

Life Cycle: Nearly 96% of the adults were collected between 19 March and 24 April. About 4% were found in June, including four teneral adults 27–30 June; two additional adults were collected 22 and 24 August from marshes that had been dry until flooded by heavy rain. This suggests a type 2 *Agabus* life cycle.

Identification: Numerous small punctures at intersections of the impressed lines that form elytral meshes, along with rather broadly rufous elytral margins, are quite distinctive. Female adults are dimorphic; 45 of 100 had a very coarse elytral sculpture with deeply impressed lines and very small meshes. These females resemble *A. anthracinus*, but the meshes are smaller, the underside of the head is rufous to rufopiceous instead of black, and the prosternal process is not apically elongate as in *A. anthracinus*. Often the epipleuron in *A. falli* adults is somewhat lighter than the metasternum and occasionally it is rufous, which may cause confusion at couplet 6 of the key; however, it is never testaceous as in species that run to couplet 20.

***Agabus fuscipennis* (Paykull, 1798)** = *A. ontarionis* Fall, 1922

Distribution and Abundance: Not yet found in Wisconsin. Range: YK-ON.

Habitat: Adults occurred in shallow water of *Carex* marshes (Larson 1975).

Identification: Adults are larger than other species that are mostly black ventrally, have testaceous epipleura, and fine reticulate microsculpture that is irregular in shape on the disc. In addition to characters in the key, the metatibia has a row of posteroventral punctures that extends its entire length.

***Agabus gagates* Aubé, 1838**

Distribution and Abundance: Rare in south-central area (Table 1). County record: 57. Range: ON-NS-NC-WI

Habitat: All adults were collected from small woodland pools at the headwaters of Otter Creek, a soft-water stream.

Life Cycle: Adults, which undoubtedly overwintered, were found between 20 April and 8 June; none were teneral. Too few collections were made to hypothesize a life cycle.

Identification: The relatively large size and rufous to rufopiceous venter and epipleura make adults of this species relatively easy to recognize. Large dorsal punctures on the outer side of the first three metatarsal segments are found in adults of only one other species, *A. erichsoni*; the key readily separates adults of these two species.

***Agabus immaturus* Larson, 1991**

Distribution and Abundance: Very rare in northeast (Table 1). County record: 18. Range: WI+MI+NB.

Habitat: Two females were collected from sedge marshes 16 and 19 June.

Life Cycle: A type 3 *Agabus* life cycle is most likely since this is the life cycle found in other members of Larson's *confinis*-group.

Identification: Adults are similar to teneral specimens of *A. phaeopterus*, *A. canadensis*, and *A. subfuscatus*, but the gula and metacoxal plates are rufous and lighter than the piceous metasternum, while they are darker or the same color in teneral adults of *A. phaeopterus* and *A. subfuscatus*; in mature specimens of those three species all of these structures are black. Adults of *A. immaturus* are probably larger than those of most *A. phaeopterus* and smaller than those of most *A. subfuscatus*; Wisconsin females were 7.8–8.0 mm long. As in *A. phaeopterus* and *A. canadensis*, the pronotum is inflated.

***Agabus inscriptus* (Crotch, 1873)**

Distribution and Abundance: Uncommon statewide (Table 1). County records: 3, 5–6, 8, 19, 26, 33–34, 37, 45, 48, 54, 57, 59, 61. Range: AK-NF-NH-WI-MN+CO.

Habitat: Adults were collected from ponds, marshes, sloughs, and swamps. Almost two-thirds of the specimens were collected in August from swamps or other habitats with *Sphagnum*.

Life Cycle: The only teneral adult was trapped 30 May, which suggests that overwintering eggs hatch in early spring and larvae complete development in late spring. Adults (11) collected before 30 May (23%) indicate that significant numbers overwinter, probably in terrestrial habitats as evidenced by an absence of collections after 3 September. This species probably has a type 3 *Agabus* life cycle, but the semivoltine segment may be substantial due to the cold *Sphagnum* habitat in which many larvae apparently develop.

Identification: Most adults are smaller than those of similar species and have darker elytra. The elytral sculpture on the disc is distinctly uneven, with numerous very small meshes along with slightly larger ones of varying sizes and shapes. Adults resemble small, dark *A. phaeopterus* adults, but in that species an inflated pronotum hides the anterior portion of the lateral bead when viewed from above and elytral meshes are very uniform in size. The posterior protarsal claw of males is not modified as in males of *A. phaeopterus* or the larger *A. subfuscatus*. *Agabus inscriptus* adults should not be confused with those of *A. discolor*, *A. canadensis*, or *A. immaturus* because in those species lateral margins of the pronotum are broadly rufous; in *A. inscriptus* adults little more than the lateral bead on the pronotum is rufous.

***Agabus leptapsis* (LeConte, 1878)**

Distribution and Abundance: Rare in northern third, very rare in southern third (Table 1). County records: 9, 17–19, 57. Range: YK-NF-NY-WI.

Habitat: Ten adults (3 teneral in 4 collections) were found in shallow woodland ponds. The remaining two adults (both teneral) were collected from a vegetated slough adjacent to a river, which is the habitat described for this species by Larson (1989).

Life Cycle: Ten adults, five of which were teneral, were trapped 16–19 June, 1986 in the north and two more were trapped 21–24 June, 1993 in the south. This indicates that larvae complete development in early June, but the type of life cycle remains unknown.

Identification: The black color (except teneral specimens), large size, large elytral meshes with reticulate secondary microsculpture, sinuate base of the pronotum, and confluent punctures on the metatibiae make adults of this species distinctive.

***Agabus obtusatus* (Say, 1823)**

Distribution and Abundance: Not yet found in Wisconsin. Range: ON-NS-NC-IA.

Habitat: Collections by Michael and Matta (1977) suggest an association with slow streams, backwaters, beaver ponds, and impoundments.

Identification: The short, pale, sublateral streak and apical spot on each elytron along with the unusual shape (widest at middle of elytra) separate adults from other species in the western Great Lakes region. Adults most resemble those of *A. semivittatus*, but the sublateral pale streak is much shorter, and the apical portion of the prosternal process is extremely flat and lacks the greatly widened margin found in *A. semivittatus* (Fig. 2).

***Agabus opacus* Aubé, 1837 = *A. pseudoconfertus* Wallis, 1926**

Distribution and Abundance: Not yet found in Wisconsin. Range: AK-NF-MA-WA.

Habitat: Larson (1975) collected most adults from "margins of small woodland pools, usually in mats of *Calamagrostis canadensis*."

Identification: Adults are very similar to those of *A. wasastjernae*, but are distinctly larger. The basal protarsal segment of the male is expanded and about twice the width of the distal segment; these segments are about the same width in *A. wasastjernae*.

***Agabus phaeopterus* (Kirby, 1837)**

Distribution and Abundance: Common in northern two-thirds, uncommon in southern third (Table 1). County records: 1–6, 9–21, 23, 26, 30–31, 33–38, 40, 42, 44–49, 51–52, 57, 59, 61, 66. Range: AK-NF-MA-WI-ND+CO.

Habitat: Most adults were collected from open or woodland ponds, but several were also found in marshes, bogs, and swamps. All teneral adults (11 collections) were found in shallow ponds or sedge marshes. Many teneral adults were among 222 adults trapped from receding waters of a northern *Carex* marsh.

Life Cycle: About 86% of the adults were collected in June; teneral adults occurred 4–27 June and larvae believed to be this species were found from 11 April through 9 June. Only 6% of the adults were collected before June, mostly from 28 March through April. The remainder were found from 1 July through 16 September. This indicates a type 3 *Agabus* life cycle.

Identification: Elytral pigmentation varies from testaceous to fuscous.

Adults with infuscate elytra resemble those of *A. subfuscatus*, but they are almost always smaller than that species. Large *A. phaeopterus* adults can be separated from those of *A. subfuscatus* by characters in the key. The posterior protarsal claws of males of these two species are diagnostic (Figs. 5–6). Separation of adults from those of *A. inscriptus* is discussed under that species. Barman (1972) described the larva.

Agabus punctulatus **Aubé, 1838**

Distribution and Abundance: Common in southern two-thirds, rare in northern third (Table 1). County records: 2, 6, 12, 21, 24–25, 27, 29, 35, 39–40, 42–48, 52–53, 57–59, 61–64, 66–67, 70–71. Range: YK-AB-LB-WI-ND.

Habitat: Almost all adults were collected from ponds, mostly in open areas.

Life Cycle: All teneral adults (25) were collected 2–30 June. Larvae believed to be this species were found 24 May through 19 June, with one additional larva being collected from a northern swamp on 22 August . About 79% of the adults were collected from 20 February through April, all except a few between early March and mid-April. Another 19% of the adults were collected in June, when emergence occurred; only 3% were found in May. None were collected between 8 July and 6 October, when one was found; two more were collected from a pond on 6 November. Sixty-five adults were trapped from snow-melt water in McKenna 5–9 Pond March, 1992, when the bottom and margins of the pond were solidly covered with ice. While I believe this species probably has a type 1 *Agabus* life cycle, with adults flying to deep ponds to overwinter and thus escape detection, it is possible they overwinter in terrestrial habitats.

Identification: The small size and aeneous dorsal surface of adults is distinctive. Elytral microsculpture consists of small, irregular-sized meshes with numerous micropunctures in the lines. Females are dimorphic, with some having longitudinally elongated meshes with a secondary microsculpture.

Agabus semipunctatus **(Kirby, 1837)**

Distribution and Abundance: Very common in northern two-thirds, common in southern third (Table 1). County records: 1–8, 10–23, 25–27, 29–45, 47–49, 51–54, 57, 59–61, 63–65, 67–68, 71–72. Range: AK-NF-NJ-IL-MN.

Habitat: Adults were collected from a variety of shallow ponds, marshes, and swamps. All teneral adults were collected from marshes and swamps, but only five collections contained teneral adults.

Life Cycle: No adults were collected after 22 August or before 25 March, which indicates that they overwinter in terrestrial habitats. Almost 94% of all adults were collected from 25 March through April, mostly in early April. Teneral adults were collected 21 to 30 June, and also on 13 and 14 August from cold swamps. Third instar larvae that I believe to be this species were found 5 May to 24 June, with one additional larva being collected on 23 July in the north. This suggests a type 2 *Agabus* life cycle.

Identification: Adults are easily identified by their small size and an almost solid black dorsum with rufous head spots, narrowly rufous lateral margins of the pronotum, and a rufous sublateral streak on each elytron. The fine elytral microsculpture has very small meshes of irregular shape and size that are about as large as the micropunctures. The head and prothorax are black ventrally, except for the mouthparts. The distinctive sublateral streaks on the elytra may be obscure, and in about 3% of the specimens cannot be seen.

Agabus semivittatus LeConte, 1852

Distribution and Abundance: Uncommon in southern third and in east-central area (Table 1). County records: 44, 47-48, 50-51, 54-57, 59-62, 65, 67-68, 70-71. Range: WI-ON-VA-TX-UT-NE.

Habitat: Adults normally occurred in streams, seeps, and spring ponds; occasionally they were found in lentic habitats.

Life Cycle: Two very teneral adults were collected from a spring pond on 8 November, indicating larvae complete development in late summer and autumn. Three-fourths of the adults were collected between 2 March and 12 May, showing that they overwinter in aquatic habitats. Only 6% of the adults were found from July through October. The life cycle is probably very similar to that described below for *A. seriatus*, another lotic species.

Identification: No other species in this region has the margin on the prosternal process greatly widened between the posterior third of the mesocoxae (Fig. 2). The very long sublateral pale streak on each elytron, which often reaches the apical pale mark, makes this species easy to recognize, but in older specimens this mark is dark rufous and not as obvious. Barman (1972) described the larva.

Agabus seriatus (Say, 1823)

Distribution and Abundance: Common in southern third, uncommon in northern two-thirds (Table 1). County records: 2-3, 12, 14, 18, 24, 26, 28, 30-31, 38, 42-44, 46, 48-51, 53-57, 60-62, 64, 67-68, 70-71. Range: YK-NF-VA-CA.

Habitat: All adults and larvae were collected from lotic habitats, especially small, spring-fed streams.

Life Cycle: Adults were found in streams from February to November, but only 9% were collected from July through September. Five collections of teneral adults were made between 3 August and 22 October. Numerous larvae were collected between 12 May and 30 August. I believe adults are the predominant overwintering stage, but a large larva on 7 May suggests that some larvae may overwinter. Most larval development probably occurs from late spring through the summer, with development progressing slowly because of the cold water in the spring-fed streams they inhabit. Pupation and emergence occurs in late summer and autumn. Most overwintering adults probably die after mating and oviposition, accounting for low numbers found throughout the summer.

Identification: Adults are identified by their lotic habitat, relatively large size and elongate shape, their almost uniform black color, and small meshes on the elytra that often contain micropunctures of varying sizes. Matta (1986) described the larva.

Agabus subfuscatus Sharp, 1882

Distribution and Abundance: Fairly common in southern two-thirds, uncommon in northern third (Table 1). County records: 6-7, 11-12, 14, 18-21, 25, 27-30, 32-40, 42, 44-45, 48-50, 52, 54-55, 57, 61, 63, 66-68, 70-72. Range: MB-PE-VA-AR-MN.

Habitat: Most adults were collected from ponds, including all teneral specimens; several adults were also found in marshes and a few occurred in other habitats. I believe small ponds are the typical breeding habitat.

Life Cycle: Less than 10% of the adults were collected in April and May, 73% were found in June, and 16% occurred from 1 July to 17 September, all in habitats described above; one additional adult was found in a spring pond on 1 October. All teneral adults (10) were collected between 2 and 18 June. Larvae

that I believe to be *A. subfuscatus* were found 1 April to 23 May, with third instar larvae occurring after 27 April. This species probably has a type 3 *Agabus* life cycle. One adult that was collected from under the bank of a large river on 21 November may have been overwintering above the water line. –

Identification: Male adults can be distinguished from similar species by their modified posterior protarsal claw (Fig. 5). The elytra, which are deeply infuscate except near the lateral margins, are darker than in *A. canadensis*, *A. immaturus*, and most *A. phaeopterus*, but many adults of *A. phaeopterus* are similarly infuscate. Some adults have irregular meshes on the disc of the elytra and resemble those of *A. inscriptus*, but adults of that species are distinctly smaller and males do not have modified protarsal claws.

***Agabus thomsoni* (J. Sahlberg, 1871)**

Distribution and Abundance: Not yet found in Wisconsin. Range: AK-NF-NH+WY+CO.

Habitat: Larson and Nilsson (1985) described the habitat as "small pools – which have firm substrates but which may be ringed by mosses and may also have dense stands of emergent *Carex* or *Juncus*."

Life Cycle: A type 3 *Agabus* life cycle is most likely since this is the life cycle found in other members of Larson's *confinis*-group.

Identification: Adults can be separated from those of *A. discolor*, which they most resemble, by characters in the key.

***Agabus wasastjernae* (C.R. Sahlberg, 1824) = *A. kenaiensis* Fall, 1926**

Distribution and Abundance: Uncommon in northern third (Table 1). County records: 10, 12–13, 15, 18–19. Range: AK-NF-WI-UT.

Habitat: All adults were collected from swamps, bogs, or sedge marshes that contained *Sphagnum*.

Life Cycle: Adults were collected between 23 April and 14 August; none were teneral. There is too little information to predict a life cycle.

Identification: These small, black beetles can be separated from adults of other species with distinct secondary microsculpture by characters in the key. They are very similar to adults of the larger *A. opacus*; separation is discussed under that species. Nilsson (1982) described the larva.

Ilybius Erichson, 1832

The life cycle is apparently very similar for all species of *Ilybius* in Wisconsin and will not be repeated below under each species. Third instar larvae are the primary overwintering stage and complete their development in late spring. Almost all adults emerge between late May and early July, mate, oviposit in permanent habitats, and die. Eggs hatch in mid-to late summer, and larvae develop to the third instar and overwinter, thus completing a univoltine life cycle. A small number of adults overwinter in terrestrial habitats (Galewski 1964) and return to breeding sites mostly in May to mate and oviposit. These adults, which undoubtedly spent the previous winter as larvae, would thus complete a semivoltine life cycle for a portion of the population. I believe overwintering adults are individuals that did not mate in the previous summer.

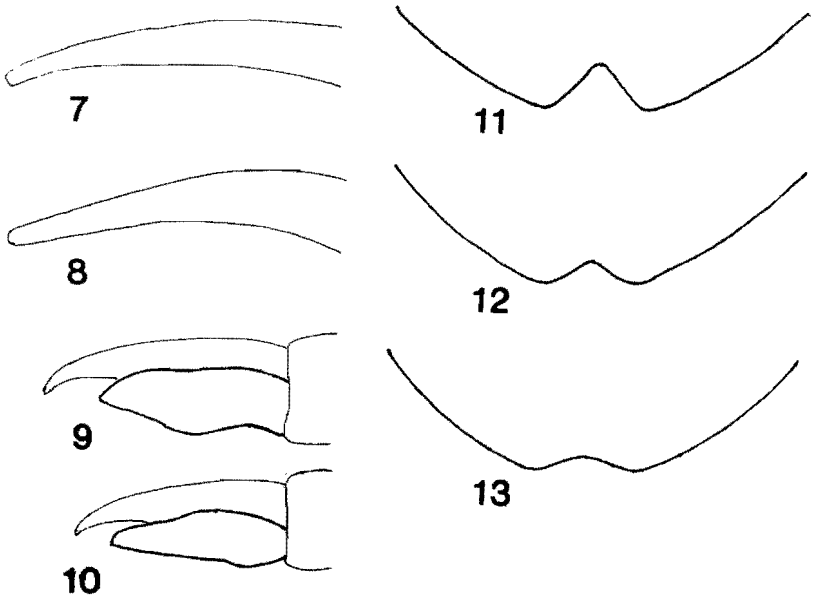
Although Nilsson (1986) found that species of *Ilybius* have a semivoltine life cycle in northern Europe, there is considerable evidence that species of *Ilybius* in Wisconsin have a mostly univoltine life cycle (Hilsenhoff 1986) because the warmer climate permits most overwintering third instar larvae to

complete development much earlier than in northern Europe. Almost all teneral adults were collected between late May and early July, which would allow ample time for them to mate and oviposit in suitable permanent habitats. Second instar larvae were found between 22 August and 18 October, and third instar larvae between 11 September and 4 May. Only 1.5% of all adult *Ilybius* were overwintering adults that were collected before 30 May, when teneral adults began to appear. Only in *I. angustior* (11.1%) and *I. ignarus* (8.1%) was this percentage higher than 2.8%, and in three species no adults were collected before 30 May. Such a small overwintering population could not sustain a species unless a univoltine life cycle also existed. From 30 May to 20 June numbers of *Ilybius* adults steadily increased, and during this period more than 20% of the adults were teneral. Peak numbers of adults (except *I. fraterculus*) occurred from 21–30 June, when only 3.5% were teneral and 20.6% of all adults were collected.

No descriptions of *Ilybius* larvae from North America have been published, but Nilsson (1981, 1982) described larvae of 2 Holarctic species (*angustior* and *subaeneus*). I was able to recognize larvae of seven different species from Wisconsin, but reared only larvae of *I. fraterculus* and *I. biguttulus*; I was unable develop a reliable key to species of larvae.

Key to Species of Adult *Ilybius* in Wisconsin

1. Metasternum and metacoxae black or piceous, except in teneral specimens, and similar to color of elytra; elytral sculpture with small, irregular, but elongated meshes, or with distinct reticulate microsculpture 2
   Metasternum and metacoxae rufous to rufopiceous, lighter than elytra; elytral sculpture with several elongated meshes in basomesal fourth 5
2(1). Metatibia punctate over almost entire ventral surface 3
   Metatibia with distinct punctures confined to base and anterior of ventral surface 4
3(2). Epipleura and prosternum rufopiceous and paler than other thoracic sterna; penis tapering to narrow, faintly reflexed apex (Fig. 7); shorter metatarsal claw of male with ventral margin sinuate at middle and slightly expanded just beyond (Fig. 9); 9.4–10.2 mm long ..... *angustior*
   Epipleura and prosternum same color as other thoracic sterna, usually black; penis with apex parallel-sided apically and rounded at tip (Fig. 8); shorter metatarsal claw of male narrowed from middle to near apex (Fig. 10); 8.5–9.8 mm long ..... *picipes*
4(2). Elytral sculpture of moderate-sized meshes, each mesh with several meshes of secondary microsculpture; 7.5–9.0 mm long ... *discedens*
   Elytral sculpture of irregular meshes too small to have several meshes of secondary microsculpture; 8.1–9.6 mm long ..... *ignarus*
5(1). Metatibia punctate over almost entire ventral surface 6
   Metatibia with distinct punctures confined to base and anterior of ventral surface 7
6(5). Sides of elytra and pronotum broadly rufous; sublateral pale streak elongate, broad, and distinct (1.5 x 0.3 mm); very large, 11.2–13.0 mm long ..... *pleuriticus*
   Sides of elytra and pronotum not broadly rufous; sublateral pale streak < 1.0 mm long; smaller, 8.9–11.1 mm long (Larson 1987) ..... *subaeneus*



Figures 7–13. 7–8. Apical 1.0 mm of penis. 7. *Ilybius angustior*. 8. *I. picipes*. 9–10. Right metatarsal claws (dorsal view). 9. *I. angustior*. 10. *I. picipes*. 11–13. Apical portion of last abdominal sternum of female. 11. *I. fraterculus*. 12. *I. biguttulus*. 13. *I. incarinatus*.

7(5). Metasternal wing very narrow, WC/WS (Fig. 1) > 5.0; 8.9–10.7 mm long (Larson 1987) ..... *oblitus*
Metasternal wing broader, WC/WS < 4.0 8
8(7). Head almost entirely rufous, with small darker area between eyes; metasternal wing quite narrow, WC/WS > 3.3; larger 10.8–12.2 mm long ..... *confusus*
Posterior of head dark, with pair of rufous spots between posterior margin of eyes; metasternal wing broader, WC/WS < 3.3; mostly smaller, < 11.4 mm long 9
9(8). Subapical pale spot on elytra absent or obscure, more obscure than submarginal pale streak; parameres with tapered setae on mesal face; notch in last abdominal sternum of female almost a right angle (Fig. 11); 9.6–11.4 mm long ..... *fraterculus*
Subapical pale spot on elytra usually distinct, at least as distinct as submarginal streak; parameres with sucker setae on mesal face; notch in last abdominal sternum of female obtuse (Figs. 12–13); 8.7–10.6 mm long 10
10(9). Male with apex of last abdominal sternum carinate; most meshes on basomesal fourth of elytra not elongate, rarely more than 3 times as long as wide; female with apex of last abdominal sternum obtusely notched (Fig. 12); 9.3–11.0 mm long ..... *biguttulus*
Apex of last abdominal sternum in male not carinate; many meshes on basomesal fourth of elytra elongate, often more than 5 times as long

as wide; notch in apex of last abdominal sternum of female very obtuse (Fig. 13)..... *incarinatus*

Ilybius angustior **(Gyllenhal, 1808)**

Distribution and Abundance: Rare in north (Table 2). County records: 2, 6, 9, 17–18, 24, 37, 43. Range: AK-NF-VA-ND-WA+WY+CO.

Habitat: Collections were made in cattail ponds, a spring seep, a beaver pond, a river slough, and the margin of a river. Five of the nine adults, including two teneral specimens, were associated with lotic habitats.

Life Cycle: Adults were collected between 9 May and 16 September; most were found in June, including teneral specimens 14 and 18 June, and 14 July.

Identification: Adults are very similar to those of *I. picipes*, but characters in the key readily separate these species. Except in teneral specimens, adults of *I. picipes* are usually entirely black, and distinctly darker on the prosternum than those of *I. angustior*. Teneral females cannot be reliably separated from *I. picipes*.

Ilybius biguttulus **(Germar, 1824)** (includes *I. laramaeus* LeConte, 1859)

Distribution and Abundance: Common statewide (Table 2). County records: 1–2, 4–21, 23–27, 29–40, 42. 44, 46–53, 55–58, 60–64, 66–68, 71–72. Range: MB-NF-GA-MO-NM-UT-ND.

Habitat: Most adults were found in permanent ponds and marshes, but several were also found along margins of streams and in other habitats such as sloughs and swamps. Eighteen percent of the 64 collections of larvae that I believe to be this species were from margins of streams. *Ilybius biguttulus* apparently breeds in a variety of lentic and lotic habitats.

Life Cycle: All teneral adults (18), except two, were collected between 30 May and 2 July. Two were found in northern sites on 20 July and 24 August, the latter in a cold *Sphagnum* swamp.

Identification: Male adults that are not teneral are unlikely to be confused with any other species. Other species in which male adults have a carina on the last abdominal sternum have either black venters (*angustior, picipes, ignarus*) and/or punctures covering most of the ventral surface of the metatibia (*angustior, picipes, subaeneus, pleuriticus*). Because basomesal meshes of male adults are not appreciably stretched, teneral males that lack pigmentation may be confused with those of the generally smaller *I. ignarus*. However, the anterior protarsal claw is not sinuate on the inner margin as in *I. ignarus*. Female adults resemble those of *I. incarinatus* and *I. fraterculus*, but in both of those species females have numerous elongate meshes in the basomesal fourth of their elytra; in *I. fraterculus* adults the subapical pale spot on the elytra is absent or extremely obscure.

Ilybius confusus **Aubé, 1838** (= *I. denikei* Wallis, 1933)

Distribution and Abundance: Rare in northwest, west-central, and southeast areas (Table 2). County records: 7, 25, 70. Range: ON-ME-MD-WI+NE+NS.

Habitat: One adult was collected from the margin of a stream in June; the remainder, including all teneral adults, were found in permanent ponds.

Life Cycle: All collections were made between 8 June and 20 July, with 7 teneral specimens (3 collections) being found between 8 and 19 June.

Identification: Adults most closely resemble *I. incarinatus*, but all Wisconsin specimens were distinctly larger than that species. Their large size, narrower metasternal wings, and mostly rufous head set them apart from

other species, all of which normally have a black head with two rufous spots between the posterior third of the eyes.

Ilybius discedens **Sharp, 1882**

Distribution and Abundance: Common in northern third to rare in central area (Table 2). County records: 1–6, 8, 11–13, 15, 17–18, 33–34. Range: AK-NF-WI+IL.

Habitat: Almost all collections were from *Sphagnum* swamps, which usually also contained black spruce and tamarack.

Life Cycle: Only one adult was collected (26 April) before 20 May, and none were collected after 27 August. Teneral adults were collected 23 June and 14 August. Larval development is probably completed later than in other species because of the colder habitat, which suggests that a semivoltine life cycle may occur in a larger portion of the population.

Identification: Characters in the key should separate adults from those of other species with black venters. In addition, males have a distinctly emarginate last abdominal sternum, an elongate penis that is recurved near the tip, and lack sucker setae on the parameres. Female adults have natatory setae on the inner (ventral) margin of the metatibia and first metatarsomere, which are found only in males of other species of *Ilybius*.

Ilybius fraterculus **LeConte, 1862**

Distribution and Abundance: Fairly common in southern two-thirds, uncommon in northern third (Table 2). County records: 1, 3, 6, 11, 21, 24–25, 38, 43, 47–49, 58–59, 61, 67–68, 70–72. Range: NT-MB-MI-SD-NM-CA-BC+NY.

Habitat: Adults were found in permanent ponds in open areas. Eighty-six percent of the adults were collected from McKenna Pond, a normally permanent pond with cattails, bur-reeds, and sedges along its margins.

Life Cycle: Adults were collected 21 May to 6 October, 89% of them in June and July. Only 0.8% were collected before 30 May and less than 6% were found after August. Numerous teneral adults were collected between 1 and 16 June. In 1976 the first teneral adult was collected from McKenna Pond on 1 June, and on 9 June, 348 adults were collected; about 20% were teneral and the remainder obviously had emerged recently. The next sample on 23 June contained 177 adults, none of which were teneral.

Identification: Almost all adults lack subapical pale spots on the elytra; rarely an obscure rufous spot is present, which is always more obscure than the rufous submarginal streak. This allows easy separation from adults of *I. biguttulus* and *I. incarinatus*, which are similar in size and color. Males lack sucker setae on the parameres, which are found in similar species, and the notch on the last abdominal sternum of females forms nearly a right angle; it is obtuse in *I. biguttulus* and *I. incarinatus*. The subapical spot may be rufous and rather obscure in some *I. confusus*, but that species has a narrower metasternal wing (WC/WS $>$ 3.3; $<$ 2.9 in *I. fraterculus*).

Ilybius ignarus **(LeConte, 1862)**

Distribution and Abundance: Uncommon in southern two-thirds, rare in northern third (Table 1). County records: 9, 11, 15, 19, 26–27, 33–34, 39, 42, 44–45, 47–48, 50–51, 56–57, 59–61, 65, 67, 71–72. Range: ON-NS-NJ-WI.

Habitat: Most adults were collected from permanent marshes, but many were also collected from margins of ponds and swamps.

Life Cycle: About 78% of adults were collected in June. The remainder

were found between 18 April and 20 August . Three teneral adults were collected 9–13 June.

Identification: The black venter, small size, small meshes on the elytra, and lack of numerous punctures on the ventral surface of the metatibia distinguish adults from all other species. Separation of poorly pigmented teneral males from the usually larger males of *I. biguttulus* is discussed under that species.

***Ilybius incarinatus* Zimmermann, 1928**

Distribution and Abundance: Very rare in northern third, uncommon in central third, fairly common in southern third (Table 2). County records: 21, 26, 32, 39, 44–45, 48–52, 55, 57, 59–61, 67, 71–72. Range: ON-PQ-DC-MI-IA+TN.

Habitat: All adults were collected from permanent ponds or marshes; more than half of the adults were trapped from the Horicon Marsh, a very large marsh with numerous cattails.

Life Cycle: All adults were collected between 30 May and 24 August, except two that were found 28 September; 67% of the adults were found in June. Teneral adults were trapped between 9 and 26 June at five sites in the southern half of Wisconsin.

Identification: Separation of adults from those of *I. biguttulus*, *I. confusus*, and *I. fraterculus*, which they most closely resemble, is discussed above under those species.

***Ilybius oblitus* Sharp, 1882**

Distribution and Abundance: Not yet found in Wisconsin. Range: MI-MA-SC-LA-KS-IN

Habitat: Michael and Matta (1977) reported that "this species seems to prefer ponds or pools without detritus or leaf litter."

Identification: The very narrow metasternal wings and short prosternal process that extends only to the middle of the mesocoxae are distinctive.

***Ilybius picipes* (Kirby, 1837)**

Distribution and Abundance: Fairly common statewide (Table 2). County records: 2–4, 6–7, 9, 12–15, 17–18, 23, 25–27, 29–30, 33–34, 36, 38–40, 44, 47–48, 51, 57, 59, 61, 67–68. 72. Range: AK-PQ-IL-MN-AB.

Habitat: Adults were collected from permanent marshes, swamps, sloughs, and margins of ponds; they did not appear to be habitat specific.

Life Cycle: All adults were collected in June, July, and August, except single specimens on 7 May and 10 September. Teneral specimens (10) were found between 7 and 19 June.

Identification: Adults closely resemble those of *I. angustior*; separation is discussed under that species.

***Ilybius pleuriticus* LeConte, 1850**

Distribution and Abundance: Uncommon in northern two-thirds (Table 2). County records: 1–2, 4, 7–9, 11–13, 17, 19, 25–26, 30, 34, 37, 44. Range: YK-NF-PA-SD-BC.

Habitat: Three of four teneral adults and one-third of the other adults were collected from streams, river sloughs, and spring ponds, indicating an association with lotic or semi-lotic habitats. Most of the remaining adults were collected from permanent ponds; a few were found in marshes, bogs, or

swamps. Twenty-four percent of collections of larvae believed to be this species also were from lotic habitats.

Life Cycle: One adult was collected 4 May, and another 9 September; all others were found in June, July, and August, with 64% being collected in August. All teneral adults were collected 8–19 June.

Identification: Adults are larger than all other species, except *I. confusus* and a few *I. fraterculus*. The combination of large size, prominent submarginal pale streak on the elytra, and numerous punctures on the ventral surface of the metatibiae distinguishes adults.

***Ilybius subaeneus* Erichson, 1837**

Distribution and Abundance: Very rare in extreme north (Table 2). County record: 2. Range: AK-NF+WI+WY+UT+CO.

Habitat: The only adult, a female, was collected 1 June from a slough bordering Lake Superior at the mouth of the Cranberry River.

Identification: Adults of this species could be confused only with those of *I. pleuriticus*, which are larger, have a longer, wider sublateral steak on the elytra, and have elongated, serpentine meshes on the elytra. Elytral meshes in *I. subaeneus* are small and irregular in shape. The Wisconsin female was 10.8 mm long.

ACKNOWLEDGMENTS

I wish to thank Dr. David Larson, Memorial University of Newfoundland, for reviewing this manuscript, for providing several specimens needed for its completion, and for verifying many identifications.

LITERATURE CITED

Barman, E. H., Jr. 1972. The biology and immature stages of selected species of Dytiscidae (Coleoptera) of central New York State. Ph.D. Diss., Cornell Univ. v + 207 pp.

Fall, H. C. 1922. A review of the North American species of *Agabus* together with a description of a new genus and species of the tribe Agabini. J.D. Sherman, Jr., Mt. Vernon, NY. 36pp.

Galewski, K. 1964. The hibernation of the adults of the European species of Dytiscidae (Coleoptera) out of water. Polskie Pismo Entomol. 34:25–40.

Garcia, R., K. S. Hagen, and W. G. Voigt. 1990. Life history, termination of summer diapause, and other seasonal adaptations of *Agabus disintegratus* (Crotch) (Coleoptera: Dytiscidae) in the Central Valley of California. Quaest. Entomol. 26:139–149.

Hilsenhoff, W. L. 1974. The unusual larva and habitat of *Agabus confusus* (Dytiscidae). Ann. Entomol. Soc. Amer. 67:703–705.

_____. 1986. Life history strategies of some Nearctic Agabini (Coleoptera: Dytiscidae). Entomol. Basiliensia 11:385–390.

_____. 1992. Dytiscidae and Noteridae of Wisconsin (Coleoptera). I. Introduction, key to genera of adults, and distribution, habitat, life cycle, and identification of species of Agabetinae, Laccophilinae and Noteridae. Great Lakes Entomol. 25:57–69.

_____. 1993. Dytiscidae and Noteridae of Wisconsin (Coleoptera). II. Distribution, habitat, life cycle, and identification of species of Dytiscinae. Great Lakes Entomol. 26:35–53.

James, H. G. 1969. Immature stages of five diving beetles (Coleoptera: Dytiscidae), notes on their habits and life history, and a key to aquatic beetles of vernal woodland pools in southern Ontario. Proc. Entomol. Soc. Ontario 100:52–97.

Larson, D. J. 1975. The predaceous water beetles (Coleoptera: Dytiscidae) of Alberta: systematics, natural history and distribution. Quaest. Entomol. 11:245–498.

_____. 1987. Revision of North American species of *Ilybius* Erichson (Coleoptera: Dytiscidae), with systematic notes on Palaearctic species. J. New York Entomol. Soc. 95:341–413.

_____. 1989. Revision of North American *Agabus* Leach (Coleoptera: Dytiscidae): introduction, key to species groups, and classification of the *ambiguus*-, *tristis*-, and *arcticus*-groups. Can. Entomol. 121:861–919.

_____. 1991. Revision of North American *Agabus* (Coleoptera: Dytiscidae): *elongatus*-, *zetterstedti*-, and *confinis*-groups. Can. Entomol. 123:1239–1317.

Larson, D. J., and A. N. Nilsson. 1985. The Holarctic species of *Agabus* (sensu lato) Leach (Coleoptera: Dytiscidae). Can. Entomol. 117:119–130.

Matta, J. F. 1986. *Agabus* (Coleoptera: Dytiscidae) larvae of southeastern United States. Proc. Entomol. Soc. Wash. 88:515–520.

Michael, A. G., and J. F. Matta. 1977. The insects of Virginia No. 12. The Dytiscidae of Virginia (Coleoptera: Adephaga) (Subfamilies: Laccophilinae, Colymbetinae, Dytiscinae, Hydaticinae and Cybistrinae). Res. Div. Bull. 124, V.P.I. and State Univ., Blacksburg, VA. 53 pp.

Nilsson, A. N. 1981. The larval stages of *Ilybius angustior* Gyllenhal (Coleoptera: Dytiscidae). Entomol. Scandinavica 12:194–198.

_____. 1982. A key to the larvae of the Fennoscandian Dytiscidae (Coleoptera). Fauna Nordlandica 2:1–45.

_____. 1986. Life cycles and habitats of the northern European Agabini (Coleoptera: Dytiscidae). Entomol. Basiliensia 11:391–417.

Watts, C. H. S. 1970. The larvae of some Dytiscidae (Coleoptera) from Delta, Manitoba. Can. Entomol. 102:716–728.